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FOREST PEST MANAGEMENT
Pacific Southwest Region

Report No. 83-14

3430 Evaluation
June 15, 1983

AN INFESTATION OF BLACK PINE-LEAF SCALE ON PONDEROSA PINE ON THE HAT CREEK DISTRICT, LASSEN NATIONAL FOREST

John Wm. Dale, Entomologist

ABSTRACT

An infestation of the black pine-leaf scale, Nuculaspis californica, is described. Population levels generally are moderate; some trees are beginning to show symptoms of decline. Management options are limited.

INTRODUCTION

A persistent infestation of black pine-leaf scale, Nuculaspis californica (Coleman), has been a concern of forest managers on the Hat Creek District, Lassen National Forest. The infested area was examined on March 30, 1983 by myself and Jim Allison, Forest Pest Management pathologist, Darwin Richards and Chuck Rowe, Hat Creek District, and Emmor Nile and Tom Glunt, Fruit Growers Supply Company -- an adjacent landowner. Rain occurred intermittently and visibility of crown detail was frequently poor because of the overcast.

FIELD OBSERVATIONS

The infestation occurs in parts of sections 28 and 33 along the Black Ranch Road east of Burney, California (Fig. 1). This area is covered by eastside pine type that is managed just for timber under an even-aged regimen in the sequence: precommercial thinning, intermediate cuts every 20 years, rotation at 120 years. No old-growth remains and the larger pines are presently 19-21 inches dbh and 80-85 ft in height. Ages range from 80-110 years; site index is a Dunning low III. A few junipers occur among the dominating pines, but sugar pine and white fir are rare.

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A portion of the area once occupied by a dense (2000 to 4000 stems/acre) stand of small pines was thinned 10 to 15 years ago. The leave trees are about 60 years of age (50-80 years) and 25 to 40 ft in height.

A few pitch tubes were seen, but there was no recent mortality from bark beetles among any of the size classes present. However, this may have been affected by the entrance of local wood cutters and the removal of mortality.

Dwarf mistletoe is common and most have been fairly abundant in the old overstory before its removal. Openings in the stand are irregular and a definite clumping effect is present — 200 to 600 trees/acre. Obvious signs of root disease were not present.

The scale is most abundant in the western half of the area — that closest to private property and the open Long Valley. Abundance decreases eastward toward the railroad track. Symptoms of the persistent scale infestation, such as poor needle retention and short, discolored needles, occur most often in groups of two or three larger trees. These symptoms are much less apparent in the thinned stand and are usually confined to the mid- and lower-crown levels.

Spraying of malathion (cold fogging with a ground unit) for mosquito abatement occurred on an average of once a week during the mosquito season along the Black Ranch Road from 1980 to 1982, although the frequency in 1982 was down somewhat because of cool weather. Prior to 1980, Dursban was applied aerially as a larvacide for eight years.

Coccinellid beetles are known to prey upon scales, and numberous lady bird beetles were seen in the foliage of a recently fallen pine. But coccinellids alone have never been observed to control any segment of the outbreak of this scale or to have lowered it to the point where it was not economically significant (Edmunds 1973).

LABORATORY OBSERVATIONS

Growth

Increment cores were taken from seven trees whose general appearance indicated heavy scale infestation. No cores were removed from pines with crowns appearing to be healthy, because an examination of a broken pine with a luxuriant crown found abundant numbers of scales. Cores were examined and width of annual rings measured under a dissecting microscope.

Scale Abundance

Foliage with scales was taken from several sources — pruned from the lower crown of three large pines exhibiting symptoms of decline and the mid-crown of three smaller pines in the thinned stand, twigs blown from the crowns of two pines, and a pine broken and fallen to the ground. These were placed in plastic bags, and removed to cold storage within

two days. Needles supporting scales were removed to plastic straws capped with gelatin capsules for capture of emerging parasites. One hundred forty-five fascicles of needles were removed from the twigs and one infested needles was selected from the three per fascicle, usually the middle needle when the needles were spread by pressing the fascicle between thumb and forefinger. Thirty-five needles were examined for number of scales per inch of needle length, live scales per inch of needle length, and survival. The remaining needles were examined in this fashion and results were also expressed per infested inch of needle. Sixty needles from the smaller pines in the thinning were classified by age -- current, two-years-old, and three-years-old. Only two of the twigs collected had four-year-old needles and this class was not examined.

RESULTS AND DISCUSSION

Growth

Examination of foliage indicated that the scales have been present for at least three to four years. Growth has been poor since the drought years of 1975-76 — an annual average of 25 to 50 rings per inch. The influence of the scale infestation is unknown, but it is assumed that the scales may have kept the pine from recovering to pre-drought growth rates of 18 to 25 rings per inch.

Scale Abundance

Twenty to 30 scales per inch of needle length indicate a high level of infestation that, when sustained, is deterimental to needle length and retention and tree vigor, and therefore, increment growth (Wood and Ross 1972; see FPL 91, Appendix I). It is not clear from the literature whether this high level is in terms of total scale shells or just live scales; but it appears to be total shells, for dead scales may remain on needles for more than two years (Wood and Ross 1972). Thus, the current average of 10.2 scales (Table 1) per inch of needle would appear to be a moderate infestation. Average counts of samples from 1982 needles ranged from 5 to 21 scales per inch (3 to 10 live scales/in), although individual needles with up to 50 scales per inch were observed. Counting only live scales would indicate a low infestation. However, according to Edmunds (1973), the presence of 4 or more scales/cm indicates that some trees have a severe infestation.

The present rating of a moderate infestation agress with the visible characteristics of the pines for none of the trees have the appearance of those in Figures 1 and 4, Appendix I. If the infestation rates of Edmunds (1973) are used for scale, then the 1983 needles can be expected to be 25-30% shorter than 1982 needles on those pines with the higher live scale counts. A few trees were beginning to approach the appearance seen in Figure 1.

Table 1. Abundance and Survival of Black Pine-Leaf Scale along the Black Ranch Road, near Burney, California

Needles Examined (No.)	Neelde Age (Yr)	Scales Per Inch (No.) Per Needle Length Total	Per Needle Length Live	Per Infested Length[a/] Total	Per Infested Length[a/] Live	Scale Survival (%)
20	3	2.9	1.3	5.6	2.5	48
20	2	3.4	1.4	6.7	2.7	41
20	1	9.9	5.8	21.3	12.6	58
50	1 & 2	16.7	6.0	33.6	12.0	36
35	1 & 2	11.7	4.9	--	--	47
		10.2	4.2	19.6	8.1	43

a. Scales are usually concentrated in the middle one-third or lower two-thirds of a needle.

Scale survival rates and counts of 1982 foliage indicate an increasing population (Table 1). The rate for three-year-old needles may be a result of a dispersal (May-June 1982) of crawlers from 1981 to 1980 and 1982 foliage, and the displacement of scales from 1980 by exposure to three winters.

The indications of an increasing population of scales beyond a moderate infestation is not surprising given the history of mosquito abatement in the vicinity. Drift from the repeated use of insecticides may harm the insects' natural enemies (Garcia, Hansgen and Roberts 1972). Signs of parasitism were almost absent from the needles examined with the dissecting microscope. However, numerous ladybird beetles were seen in the crown of the fallen pine and they are known predators of scales.

MANAGEMENT ALTERNATIVES

Suppression by chemicals. Several chemicals are registered for use against scale insects (Dale and Schultz 1979). However, timing is critical because the vunerable crawler stage appears over an extended period of time (Edmunds 1973), and results have been frequently unsatisfactory. Some scales always escape suppression and without other controls, they would quickly multiply. Natural enemies would not be greatly impacted for it appears that their populations are very low, possibly suppressed by drift from applications of Dursban and malathion for mosquito abatement. These applications are expected to continue.

The winter of 1982-83 has been very wet and mosquitoes should be abundant in 1983. Should these applications cease, parasites could be expected to move back into the area and effectively control the scales after a couple of years.

Site quality is not high and investment of scarce resources on such a site would seem inappropriate. Therefore, the use of insecticides is not contemplated by the resource managers.

Timber harvest. Clear cutting the site and establishing a new rotation would certainly remove the scale, but it would not remove the conditions that allowed the increase in the scale population. The appearance of a new scale infestation on the young regeneration, while not certain, would seem probable. However, the interval before reestablishment could well be lengthy because scale populations apparently have to become adapted to specific host individuals over several generations before this genetic fitness is sufficient to allow rapid population growth once biological control are removed (Edmunds 1973).

Continue present management. Present management consists of salvage and intermediate cuts every 20 years. These procedures are not aggravating the scale problem and have not contributed to it. The intermediate cuts could be used to offset the effects of the scales on tree vigor if the cuts were used to thin clumps of trees and lessen competition within these groups. Susceptibility to bark beetles also would be lessened. In the meantime, it may be necessary to plant some of the larger openings in the stand to maintain regional stocking standards.

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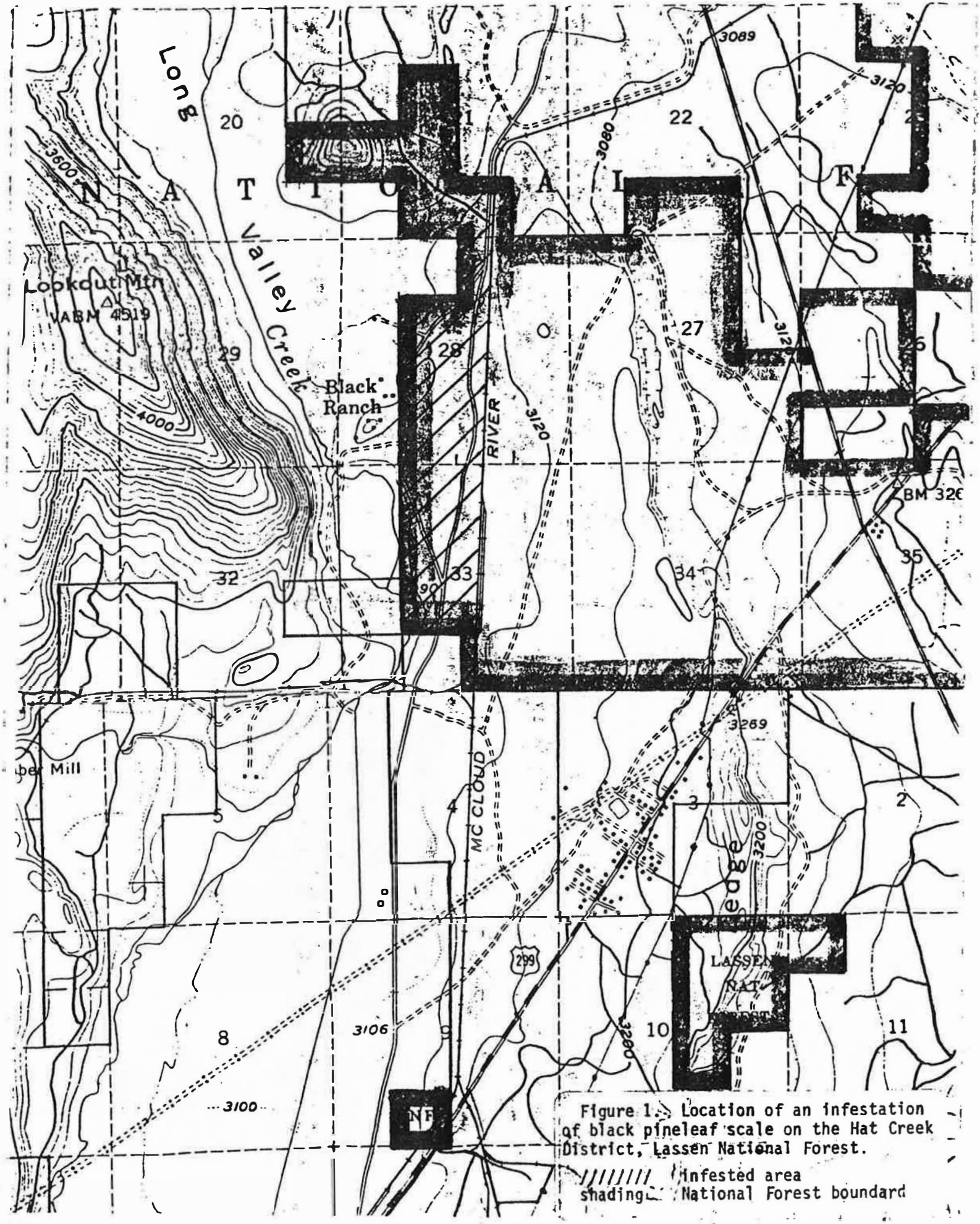

Figure 1. Location of an infestation of black pineleaf scale on the Hat Creek District, Lassen National Forest.

//////// Infested area shading

National Forest boundard

U.S. DEPARTMENT OF AGRICULTURE FOREST PEST LEAFLET 91
Forest Service November 1964

Black Pine-Leaf Scale

By George R. Struble[1] and Philip C. Johnson[2]

The black pine-leaf scale (*Aspidiotus californicus* Coleman[3]) belongs to one of the sucking insect groups commonly called armored scales (Homoptera: Diaspididae: Aspidiotini), which are important pests of agricultural and ornamental plants. The most common insect associated with the black pine-leaf scale is the pine needle scale (*Phenacaspis pinifoliae* (Fitch)).

The black pine-leaf scale infests pine foliage—injuring by removing sap and, possibly, by injecting into the tree toxic enzymes secreted in the saliva. When the insects attack in great numbers they can severely weaken or kill the host tree.

Infestations of this insect are generally localized, sometimes in just a few trees. These localized infestations have been especially frequent in sugar pine and Monterey pine stands. Occasionally, however, epidemics ravage several thousand acres of forest, where every host tree may be infested. For example, large areas of Jeffrey and ponderosa pine in southern California have suffered recurring outbreaks since 1940. Ponderosa pine stands near Cashmere and Spokane, Wash., and Penticton, British Columbia, reportedly have been severely damaged by invasions of this insect (fig. 1).

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[3] Synonomy: *Aspidiotus pini* Comstock; (*Nuculaspis californica* (Coleman)).

Range and Hosts

The black pine-leaf scale is widely distributed in North America. It has been reported in all parts of the continental United States and Canada, and in the mountainous areas of Mexico (fig. 2). Its hosts include the following pine species: Mexican pinyon (*Pinus cembroides* Zucc.), lodgepole pine (*P. contorta* Dougl.), shortleaf pine (*P. echinata* Mill.), Jeffrey pine (*P. jeffreyi* Grev. & Balf.), sugar pine (*P. lambertiana* Dougl.), ponderosa pine (*P. ponderosa* Laws.), Monterey pine (*P. radiata* D. Don), pitch pine (*P. rigida* Mill.), and Digger pine (*P. sabiniana* Dougl.). It also attacks Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco).

Symptoms of Infestation

Black pine-leaf scale infestations are commonly associated with environmental conditions harmful to the hosts. Conditions include smelter fumes, smog, smoke, and dust from such sources as roads, trails, excavations, cement plants, and poultry yards. Around orchards, the repeated use of insecticides may be associated with outbreaks of the scale if the spray drifts are strong enough to harm the insects' natural enemies.

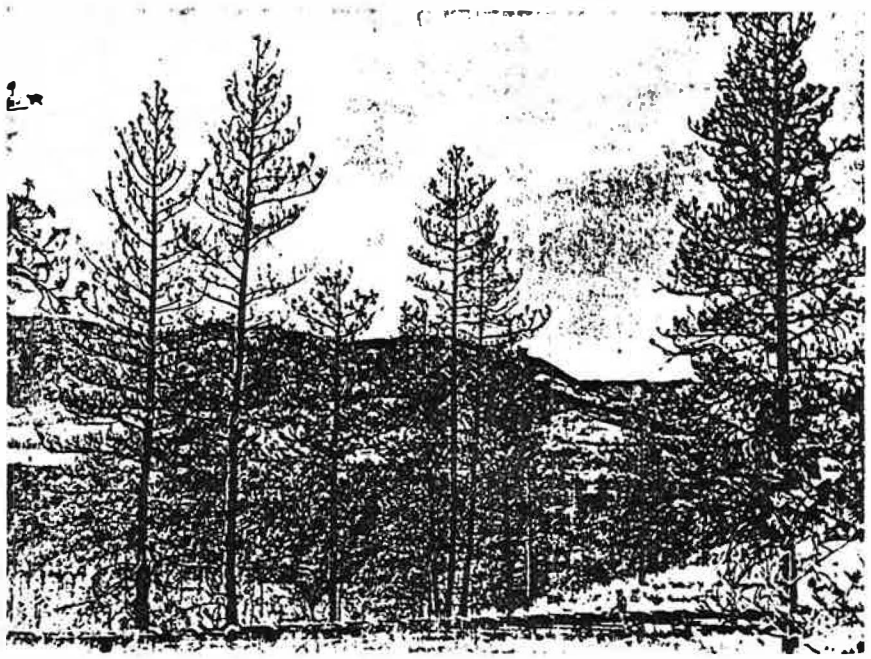

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Figure 1.—Ponderosa pines partially defoliated by the black pine-leaf scale.

Viewed from a distance trees heavily infested with the black pine-leaf scale look like those dying from bark beetle attacks. Infested trees are most noticeable in the spring when discoloration of the affected needles becomes most pronounced and is not obscured by new foliage. By fall, affected needles drop off and leave the tree with sparse, short foliage. Radial and terminal growth is also reduced.

Before dropping off, the needles of heavily infested trees become yellowish and discolored. Where the scales have fed, they are often blotched by necrotic areas which impart a patchlike pattern to the needle coloration. If looked at close up, grayish-brown to black scale bodies, often tightly packed against each other, can be seen along the needle surfaces (fig. 3).

Biology and Habits

The insect passes through three major stages in its life cycle: Egg, nymph, and adult. The yellowish eggs are nearly microscopic in size and occur in masses held together by white wax filaments underneath the female scale, which is immotile. The eggs hatch within a few days, releasing appendaged, dark amber-colored nymphs or crawlers. The crawlers move

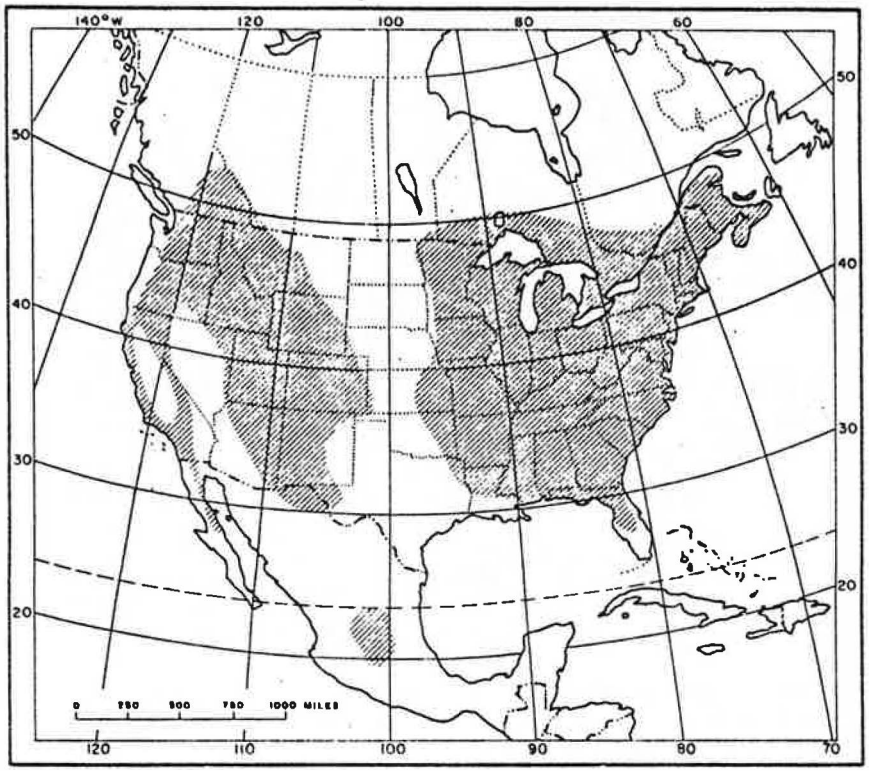

Figure 2.—Generalized distribution of the black pine-leaf scale.

about freely along the needles until they find a suitable spot to settle, usually along the angular surfaces of the young foliage. To feed, they insert their long filamentous beaks or stylets into the needles and suck the juices from the needle tissue.

At the first molt, the nymphs lose their appendages and become immotile. They then secrete over themselves a waxy covering that enlarges with subsequent molts to accommodate the growth and development of the insect.

The mature male and female scales are very similar in appearance, but the covering of the male is longer than that of the female (fig. 3). The female scales are 1 to 1.5 mm. in diameter. All scales are grayish black with lighter colored apical parts. The females are much more abundant than the males, the ratio being about 10 to 1. The adult male is very tiny and, unlike the female, is fully motile. He emerges from underneath the scale covering with legs, antennae, and wings fully developed, and can crawl about or fly.

The black pine-leaf scale has one to two generations each year, depending upon the climatic conditions in the area. In eastern Washington, toward the northern part of its range, the insect has only a single generation. Both

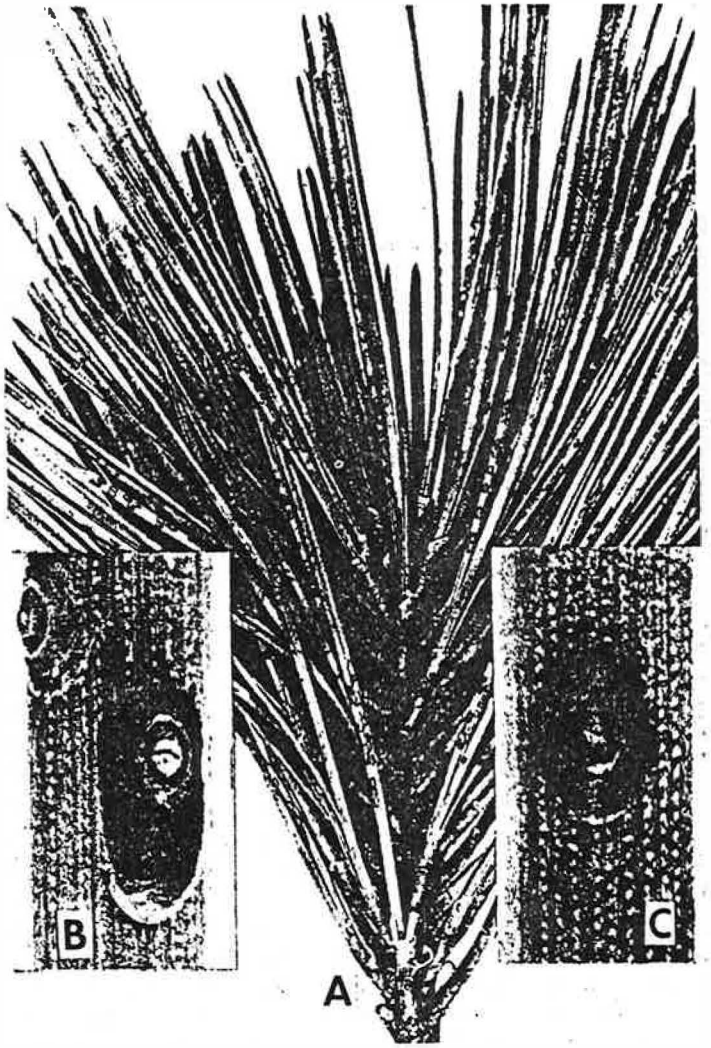

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Figure 3.—Black pine-leaf scales on ponderosa pine needles: A, Heavily infested foliage; B, scale covering male (enlarged); C, scale covering female (enlarged).

males and females mature during May. The males emerge between June 1 and 15, and mate with the immotile females. The females produce large numbers of eggs that hatch into crawlers between July 15 and August 7. Scale formation starts as soon as the crawlers settle, and the insects overwinter beneath this covering.

At the southern end of its range, the insect has two generations each year, and may have a partial third. In southern California, development is as follows: First generation—eggs, April to May 15;

crawlers, May 15 to June 15; scales, June 15 to July 15; second generation—eggs, July 15 to August 1; crawlers, August 1 to 15; scales, September 1 to October 15. The insects overwinter beneath the scales, but if warm weather prevails during fall and early winter, some may complete their development and start a new cycle.

Only in the crawler stage do both male and female insects move about freely. Most dispersion of populations takes place during this stage. Although the crawlers are able to migrate to some extent, many undoubtedly are transported to new hosts by air currents, birds, and possibly some of the larger flying insects.

Effect on Host Tree

Light populations of the black pine-leaf scale, up to 0.5 scale per inch of needle length, do not noticeably damage trees with normal healthy foliage. But heavy populations reduce the number, length, and retention period of the needles. Heavily infested ponderosa pines seldom retain more than 2 years' needle growth; normal retention is 3 to 5 years. When infestations reach 20 to 30 scales per inch of needle length, and remain at these high levels for several years, the tree produces fewer, shorter, and more yellowish needles each season (fig. 4) until it can produce no more.

Needle damage caused by scales is distinguished from that caused by chemically contaminated air or smog by the pattern of discoloration. Scale attacks cause the needles to become blotchy and necrotic. As the attacks progress, the needles turn yellow before they die. Needles affected by contaminated air discolor evenly, especially toward their tips, and give rise to a condition sometimes called tip burn.

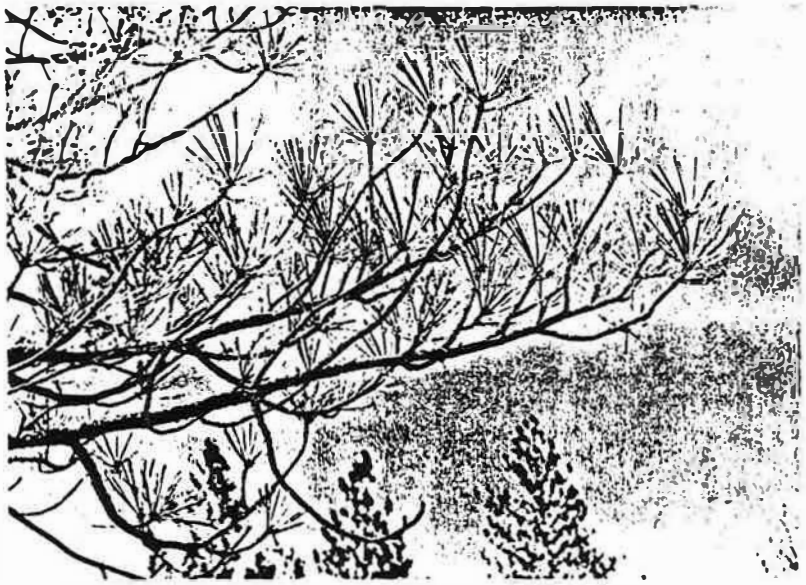

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Figure 4.—Sparse, short needles on ponderosa pine suffering from persistent infestations of the black pine-leaf scale.

Control

Natural enemies and climate are important in checking black pine-leaf scale populations. In at least one case, heavy scale mortality resulted from desiccation of the foliage during an unseasonably cold (7° to 25° F.) March that followed a period of unusually warm weather, which had stimulated tree growth.

At least three species of parasites attack the scale: *Physcus howardi* Compere, *Prospaltella aurantii* (Howard), and *Aspidiotiphagus citrinus citrinus* (Craw.). Ladybird beetles also prey on it. The relative importance of these insects, however, is not known.

Infestations can be reduced below damaging levels by properly timed sprays. Malathion or guthion have been highly effective. In experimental studies, complete kills were obtained with formulations of 1½ to 3 pounds of malathion and 1 gallon of light summer oil in 100 gallons of water. Spray formulations of 1½ to 3 pints of 25-percent liquid emulsifiable guthion for each 100 gallons of water have given equally effective results. Sprays of this type should be timed to coincide with the 2-week period when crawlers are active and before they settle and become covered with scales. The proper time to spray can best be determined by frequent sampling of the populations. Sprays should be applied with high pressure equipment to the point of runoff.

Caution: Malathion and guthion are toxic compounds; indiscriminate use can endanger people, domestic animals, wildlife, and fish directly and by contaminating water supplies. Malathion is much the milder of the two, but precautions must be taken in mixing and applying either material. Read the label on the container. Wear protective clothing. Avoid spilling, contact with the skin, or excessive inhalation. Wash exposed skin with soap and water. Always mix and apply formulations in the open.

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